SUBJECTIVE TELEPATHIC EXPERIENCES, GEOMAGNETIC ACTIVITY AND THE ELF HYPOTHESIS:

Part II. Stimulus Features and Neural Detection

Michael A. Persinger, PhD
Department of Psychology
Laurentian University
Sudbury, Ontario, Canada

Possible neural mechanisms by which telepathic or clairvoyant (T-C) experiences might be mediated are discussed. If T-C stimuli evoke long-term potentiation (LTP) within the experient's hippocampus, then specific changes within the temporal lobe (including modification of memory consolidation) could occur for hours, even after only a few seconds of stimulation. Periods of temporal lability, such as dreaming, twilight states or decreased vigilance, would increase the likelihood of both detection and response to T-C stimuli. There is no requirement that the T-C stimulus contain all of the information for the experience because simple but specific patterns of stimulation can access the representations of complex memories and images that are stored within the cerebral cortical columns of the experient. It is suggested that T-C stimuli are mediated through an ELF mode since both T-C experiences and ELF propagation appear to be facilitated during periods of quiet, global geomagnetic activity. (Author's abstract).

Introduction

One of the most frequent types of strong, subjective psi experiences involves reports of death or crisis to friends or family members [1]. The reports are traditionally classified as telepathic or clairvoyant experiences,

depending upon theoretical assumptions. In approximately 70% to 75% of subjective telepathic-clairvoyant (T-C) experiences the putative agent was dying (usually suddenly). The second most common activity of the putative agent involved unexpected or serious personal crisis.

Analysis of various collections of T-C experiences has shown that they are more likely to occur during quiet geomagnetic periods. Schaut and Persinger [2] found that days on which T-C experiences occurred were significantly quieter than the days before or afterwards. Days on which T-C experiences occurred also displayed lower aa values (the measure of geomagnetic activity) than the daily averages of the months in which the experiences occurred. In contrast, a matched collection of precognitive experiences did not display any significant daily differences in geomagnetic measures.

T-C experiences during the last century also occurred on days of quiet global geomagnetic activity. Analyses [3] of more than 100 cases from the Gurney, Podmore and Myers [4] series demonstrated an effect that was similar in both direction and magnitude to the Schaut and Persinger study. There was only one major difference between the two studies. Cases from the Gurney data base that occurred on days that were not significantly quieter than the averages for the months occurred during months that were quieter than the averages for their respective years. In other words, the entire months had been unusually quiet and had displayed aa values that were similar to the days on which more contemporary T-C experiences had occurred.

We have hypothesized [2] an "optimal component" within the environment that facilitates the occurrence of T-C. This component may be present all of the time, but either not propagated in the same form, or is immersed in competing stimuli during geomagnetic disturbances. In addition, the detection of this component depends upon increased perception or detection by certain portions of the brain. This article describes the possible neuropsychological and physical mechanisms that could be involved with subjective T-C experiences.

Major Characteristics of T-C Experiences

Any realistic neural and physical mechanisms that might by hypothesized to describe and hence predict T-C experiences should also reflect their basic properties. Statistical analyses of several different collections of T-C experiences [1,3], including a sample that occurred between the years 1868 and 1886, indicate that the phenomena are markedly consistent over time. The few cross-cultural comparisons that have been made also indicate a similarity in the basic characteristics of T-C.

About half of the experients report that they were asleep during the T-C experiences concerning death, crises or illness of family members or friends. Of those who were asleep more than half report they were dreaming or had just finished dreaming. Another approximately 25% report that they suddenly awoke, a phenomenological experience that frequently follows dreaming. T-C experiences that occurred when the experients were not sleeping were associated with states of decreased vigilance. They include dozing or automatic tasks (washing dishes, cleaning the floor, and "walking without thinking").

The autonomic (affective) theme of T-C experiences is frankly stated as aversive or anxious in more than 75% of all cases. The experient often reports the physiological symptoms as well as the psychological effects of apprehension or anxiety. They include fluctuations in body temperature, trembling (shivering), sweating and alterations (increases) in heart rate. T-C experiences involved with death or crises are rarely correlated with positive affect [1].

The specific T-C experiences can vary from a vague but compelling apprehension that something has happened to the putative agent, to detailed and explicit images. In one sample of cases [1] that occurred between 1930 and 1965, about 32% involved apparitions. Here the putative agent was perceived in particular detail during the T-C experience; the descriptions most frequently reflected the situation of the agent at the time of experience, although there were also trivial errors of actual details. Hunches or strong compulsions characterized 20% of the cases and "inner

voices" dominated another 20% of the cases. The major categories have not changed since the time of Gurney, Myers and Podmore [4].

More than 74% of the putative agents in T-C experiences were dying at the time of the percipient's experience. This pattern is evident for both contemporary, historical and cross-cultural samples [5,6,7]. The second major activity of the agent was crisis. Trivial events, which are often associated with novelty, frustrative non-reward or mild punishment to the agent, characterize a small but significant proportion of the cases. However, these trivial events are probably underestimated in these samples since (unlike the more discrete and emotionally significant episodes of death and crises), they are probably more frequent (less unique) and elicit a less intense psychological effect.

The relationship between the experient and the agent (the central theme of the experience) is predicted generally by reinforcement history. Most cases involve members of the immediate family, such as husbands, wives, mothers, and fathers. The second most frequent class involve members of the distant family (aunts, uncles, grandparents) and close friends. A small number of cases involve peripheral friends or acquaintances and strangers. A frequently forgotten (or ignored) class of T-C experiences involve death or crisis to the experient's favorite animals or pets.

In both the Gurney, Myers and Podmore and the Fate samples [1] most (over 80%) of all T-C cases occurred at night. The second major fraction occurred during twilight hours; very few occurred during the day and when they did they were frequently associated with nap periods or occasions of routine decreases in vigilance. The distance between the agent and percipient ranged from a few feet to several hundred kilometers, with the median being around 10 to 100 km. However, this may be an artifact of the average living distances between friends or family members.

T-C and the Temporal Lobe: Basic Structures

The temporal lobe of the human brain has been hypothesized to be an important factor in psi experiences [8,9,10]. Essentially all of the major experiences and

characteristics of T-C phenomena have been evoked by experimental or spontaneous (epileptic) stimulation of the human temporal lobe. In addition, the temporal lobe contains structures that either directly control or have a major effect on the physiological conditions and biological periods that are associated with T-C.

The human temporal lobes extend along the sides of the brain. Their upper boundaries are the lateral sulci, within which they interface with the parietal and the frontal lobes. Caudally, the temporal lobes interface with the occipital lobes. In terms of depth, the temporal lobes can be differentiated into cortex and subcortex. The cortex facilitates multimodal interaction (integration of several sense modes) and is centrally involved with language. In addition to the classic language areas, recent evidence indicates the existence of small 1 square millimeter areas along the superior lip of the temporal lobes, which have unusual linguistic properties [11].

Like the other cortices of the brain, the temporal cortex is organized into functional columns measuring about 250 to 500 micrometers in width. Unlike other cerebral cortices, temporal lobe columns can show protracted electrical lability. This electrical lability and sensitivity may continue for days or weeks even within the normal brain. When a sufficient number of these columns within a certain area remain electrically active, they appear on electroencephalographic (EEG) records as a focus [12].

Two mutually connected major structures exist beneath the cortex. They are the hippocampus and the amygdala. The hippocampus is primarily associated with memory and with the occurrence of dreams or altered states. Dysfunctions of the hippocampus can seriously alter memory and release dreams into the waking states. The amygdala is most well known for its association with emotional experiences. Stimulation of this structure produces intense feeling of meaningfulness, usually of cosmic or religious significance. In addition the amygdala, because of its connections to the hypothalamus, has a strong influence over the autonomic nervous system, the visceral seat of the emotions.

Temporal Lobe Stimulation and T-C Experiences

If T-C experiences are associated with certain, transient conditions within the temporal lobe, then these phenomena or something very similar to them should occur in people who have chronic lability in this area [10]. Temporal lobe epilepsy is a condition characterized by a chronic electrical focus within the temporal lobe. When a small electrical seizure occurs (often without any convulsion), the person reports a dreamy state. During this period he may hear voices, feel compulsions, or see apparitional forms. The affective tone is usually unpleasant; anxiety is most typical [13].

Direct surgical stimulation of subcortical temporal lobe structures, especially hippocampus and amygdala, are associated with identical experiences [13,14], many of which constitute the essential features of T-C experiences. When small, focal currents are induced within these tissues, the percipient may hear meaningful messages, see scenes or apparitional forms, report alterations in space and time (déjà vu), or even feel as if the self has left the body (out-of-body experiences).

These experiences are not only "memories." Their content is influenced by the individual's personality as well as by the context of the social situation before the stimulation occurs. Some authors have suggested that the stimulation merely amplifies unconscious events into more vivid and obvious forms such as intense imagery or "clearer thoughts." These experiences are not unique to the epileptic brain and may be elicited in the normal brain as well [14].

These studies indicate that the temporal lobe may be the major focus through which T-C experiences are mediated. Consequently, invasive stimulation of this region should evoke the basic components of these experiences. These components should be crude and fragmented, without specific reference to a remote situation (such as the agent). These evoked components would be analogous to the visual experiences produced by stimulation of the occipital lobe. Such experiences would, by virtue of the occipital lobe's role in vision, contain all of the major components of actual visual patterns evoked by visual stimuli. However,

those patterns would not be organized by the effects of a remote stimulus.

Similarly, actual telepathic experiences would involve natural stimulation of the temporal lobe by stimuli that are related to the environment. The content of the experiences would reflect some organized veridical event. In natural situations conducive to T-C experiences, the temporal lobe would display a transient lability that would allow an organized pattern of responses to occur. Such transient periods include REM periods at night and decreased vigilance during the day.

If enhanced sensitivity of the temporal lobe is associated with psi experiences, then people who display signs of enhanced temporal lobe activity should also report more psi experiences. This pattern has been confirmed in several studies involving normal subjects [15,16]. People who reported more experiences similar to those reported by epileptic patients during surgical stimulation also reported experiencing more frequent psi experiences, particularly T-C. Examples of temporal lobe signs include "feeling slow vibrations like driving over a rolling road, just before you fall asleep," "intense meaningful sensations between 0200 and 0400 hours in the morning," "strong olfactory sensations from childhood while climbing stairs," and the "sense of presence" (of an entity).

Neuroelectrical Properties for T-C Experiences

The hippocampal-amygdaloid complex displays three types of neuroelectrical properties that are relevant to psi processes. They include kindling (progressive increase over days in electrical lability due to brief and intermittent electrical stimulation), transient coherence of large aggregates of neurons within the theta (4-7 Hz) range and long-term potentiation or LTP. In the context of T-C experiences, the most important of these is LTP, which is defined as the long-lasting postsynaptic responses that occur within certain portions of the hippocampus following brief bursts of ELF electrical stimulation. A brief burst of 100 Hz for 1 second or 200 Hz for 0.5 second can generate LTPs that last for hours. Lower frequency stimulation,

however, does not generate this condition [17].

LTP, generated by a signal 1 second, 100 Hz stimulation of Schaffer collaterals (a type of axon intrinsic to the hippocampus), also generates morphological changes. Certain types of synapses develop in numerical density within 10 to 15 minutes after the stimulation and remain for at least 8 hours. Stimulation that does not produce LTPs also does not evoke these morphological changes. In short, there exists within the hippocampus a mechanism that can generate hours of change in information processing following a very brief stimulation.

The existence of this neuroelectrical property indicates that only a few seconds of an optimal T-C stimulus would be required to produce long-term changes in the experient's hippocampus. The resulting LTPs would influence the pattern of further activity and contribute to or evoke the T-C experience, by modifying the ongoing neural ensembles. Since LTPs are also strengthened by repetition and can persist indefinitely [18], the optimal T-C stimulus might have been presented (and removed) hours before the experient enters an optimal neuropsychological state, such as dreaming or decreased vigilance, during which time the information would be accessed.

This model would be similar to more metaphorical explanations whereby psi experiences are assumed to be "trapped" in limbic areas. While in this state, the experient is not aware of these stimuli. When they become sufficiently intense (due to repetition from their source), or when the person shifts into a state that allows greater access to these limbic images, they occur as an intense and emotionally profound T-C experience of which the experient is clearly aware. Similar concepts have been developed by Neppe [9].

Hippocampal-Cortical Memory Model

One of the basic criticisms of the ELF (extremely low frequency) electromagnetic field hypotheses for T-C experiences has been the low bit rate (information rate) of transmission. The real time frames of stimulus presentation and the complexity of T-C experiences appear to rule out

this mode as a mechanism for this form of psi phenomena. One could also argue that even a multisecond, optimal T-C stimulus that evokes several hours of LTP is insufficient to produce the complexity of many T-C experiences.

Puthoff and Targ [19] have suggested that the optimal ELF T-C stimulus might only provide the skeletal information and that the percipient might "fill in" or complete the remaining information. A similar idea was provided almost a hundred years ago by Gurney, Myers and Podmore. Very recent developments in neuroscience indicate that both groups of researchers may have been correct, in principle.

Teyler and DiScenna [20] have derived a convincing, very testable model that the hippocampus is an elaborate indexing system for memory. Whereas the actual information, the large chunks of experiential detail, are stored as neuronal correlates with cortical columns of the cerebrum, the code for the sequence of how these columns may be indexed is stored within the hippocampus. For a particular memory to be experienced, the appropriate sequence of hippocampal firing must occur. This space-time pattern of hippocampal stimulation accesses specific cortical columns (that effectively are the memory) and the experience occurs.

In essence, the hippocampus would be like a card catalog system within a library while the cerebral cortices would be the books within the library. Reading the books and obtaining the massive detail is a routine procedure once it has been determined where the books are located. Without an index, the reader might have to read each book within the library (or at least its title) in order to find the one in which he was originally interested.

The DiScenna and Teyler model is particularly important for T-C experiences. It indicates that the appropriate sequence of T-C stimuli need not contain all of the information that characterizes the T-C experience. The essential requirement for the T-C stimulus is the particular pattern that will access the cortical columns. The rest of the electrical activity and the cognitive experience will be a function of the experient's own history and neuronal microcircuitry.

One perplexing feature of some T-C experiences is the error in small details, even though the general information

and the context concerning the agent or situation may be correct. For example, the experient may report that her "father's apparition" appeared at the time of his death. Although the actual time and target are correct, the apparition may have been dressed in clothes different from those worn by the father at the time of the T-C experience. In this model, the effective T-C stimulus accessed the relevant cortical columns that contained images about the father; however, other functionally-associated cortical columns containing experiential detail about the father were also accessed and integrated.

The Experient and T-C

If the temporal lobe is involved with T-C, then T-C should occur most frequently during specific conditions of electrical lability. Characteristics of T-C cases strongly suggest that dream, predream or altered vigilance states precede most T-C occurrences. If proneness towards electrical microseizures is used as an index of hippocampal sensitivity, then one of the most labile periods should occur just before and during REM (rapid eye movement) periods. Patients with very active temporal lobe structures, such as (focal) complex partial epileptic patients, often show increased subcortical spiking during these periods [21].

There is strong evidence that increased electrical activity of hippocampal structures around dream periods may be triggered **normally** by endogenous spike activity. Frequent precursors to REM periods are PGO (pontine geniculo occipital) spikes; they precede the actual onset of a dream sequence that is initiated via noradrenergic bundles from the locus ceruleus to the hippocampus. Under certain conditions, the person may report that "he suddenly awoke" and there may be strong autonomic or apprehensive correlates. These characteristics are not uncommon in T-C experiences.

Although there is a strong increase in the propensity for hippocampal lability and endogenous spiking to occur during the evening (particularly during REM periods), two other periods also show this pattern, namely, the so-called twilight states. In fact, secondary generalized seizures

are frequently observed during the twilight states just before the person awakens in the morning or falls asleep at night. T-C experiences that occur during the night but not during REM periods, generally occur during the twilight states.

During waking hours, hippocampal spike activity is more persistent before periods of normal "absences," such as staring into space. They usually are associated with stereotyped, well learned tasks that do not require vigilance, such as washing dishes or driving a car. During these periods, brief "micronaps" can occur and hippocampal lability increases briefly. One index of this condition is the increased, intense hypnagogic imagery that may occur during these periods. Other tasks that evoke these conditions are writing and walking, particularly if they are completed with "little effort."

Most procedures that generate vivid imagery also generate alterations in hippocampal activity. However, except for direct measurement, these changes are usually inferred by alterations in cortical activity as measured by the EEG. Shifts are typical, usually consisting of increases in the theta frequency range. These procedures include meditation, mild vestibular stimulation (rotation) in an opaque field and relaxation in a quiet, visually neutral environment. All have been associated with enhanced periods of experimental and spontaneous T-C experiences.

From this perspective, T-C experiences should be more common during the nocturnal period simply because the conditions that enhance temporal lobe lability are more common. During the daytime these periods are generally brief, perhaps only a few seconds in duration, and tend to cluster during changes in vigilance. During these periods the experient would be receptive to the T-C information that might be stimulating or have stimulated the subcortical temporal lobe structure.

Conditions of the Agent

Although the receptivity of the experient is essential for the experience and the report of a T-C event, presumably the experience would not occur without some discrete event

occurring for the subject of the experience, i.e., the agent. The tendency of T-C cases to reflect death and crisis of family and friends implies something about the conditions that may generate T-C stimuli. If the LTP model is assumed, these stimuli might only be generated for a few seconds.

Does this imply that T-C experiences are associated with **only** crisis or death events, or do the T-C stimuli associated with these conditions stimulate the experient in a different or more intense manner? Theoretically, there should be a continuum of stimuli that might be associated with specific behaviors of the putative agent, and the probability of their detection by the experient would vary according to his/her sensitivity and to the intensity of the stimulus. In fact, even experiences with non-traumatic content should be possible.*

Studies concerned with the neuroelectrical and neurophysiological correlates of anxiety [22] indicate that very **specific** hippocampal frequencies (within ±1 Hz) are associated with several diverse situations. The first and most powerful is punishment or pain-mediated experiences. The other situations involve novelty or frustration due to lack of an anticipated reward. All three of these situations can generate very similar transient changes in the hippocampal structures.

One of the unanswered questions concerning subjective T-C experiences is the small number of cases where the agent was not dying or in major crisis, but was exposed to a mildly frustrating or novel situation. The work by Gray [22] and his colleagues would suggest that a few cases **should** deal with what appear to be trivial situations since these would evoke changes within the agent similar to those associated with severe crisis or death. However, the intensity or duration of the latter would be greater.

What happens in the agent's brain during these T-C periods? Under death- or crisis-related conditions,

* This possibility is indicated, for example, by remote-viewing experiments in which members of the outbound team, as a rule, do not experience any crisis or traumatic situation. - Ed.

frequently associated with hypoxia, large numbers of neurons throughout the hippocampus and cortex begin to fire synchronously. In the rat brain, the frequency is usually specific to around 7-8 Hz. However, this band reflects large aggregates of neurons and does not indicate the frequency of the smaller ripples that occur locally and within the hippocampus. These are usually more within the optimal range of hippocampal stimulation, i.e., 40 to 100 Hz. The effect is potentiated by the release of norepinephrine. Thus for brief periods (in the order of seconds), large portions of the brain generate similar but specific signals.

The Agent-Experient Connection

Considering the myriad numbers of T-C stimuli that may bombard a person's brain each day, why should a specific stimulus (such as that associated with the death of a friend) be associated with a specific and relevant experience about that friend? In other words, why doesn't the optimal T-C stimulus that is associated with the person's death evoke other nonspecific experiences within the percipient? Secondly, why does stimulation from events occurring to millions of other people (apparently) not affect the experient?

There must be some source of similarity or connection between the agent and percipient such that the generation of a specific electrical change within the brain of the agent evokes a specific and meaningful response within the experient. The most likely mechanism for this coherence is learning. People with shared reinforcement histories, such as immediate family members or friends, should be (and are) the most likely candidates for T-C experiences. These individuals would have viewed the same object at the same time and would have associated verbal images generated by similar hippocampal signatures. These individuals would have likely seen each other in situations of duress or sickness and had been exposed to similar smells. Later evocation of the specific electrical patterns associated with these behaviors would stimulate relevant images in the experient.

Shared reinforcement history also includes similarities in incidental exposure to conspicuous perceptual forms. People from within the same culture may have more in common than suspected. For example, the observation (perception) of unique, complex perceptual forms (such as buildings or typewriters) may generate very specific electrical patterns within temporal lobe structures; neuronal ensembles within the temporal lobe are notorious for their ability to respond uniquely to specific complex shapes. Consequently, assuming that the experient has seen the object before, the specific pattern generated from another person's brain might evoke very specific images, even though the two people were not related by familial or friendship history.

The ELF Mode and T-C

The "ELF hypothesis" for T-C is actually a generic label for several different postulates, each varying in the specifics of characteristic frequency, source or waveform [23]. The two most popularly postulated sources are, first, the Schumann resonance whose fundamental frequency is around 7.7 Hz with harmonics that include up to 100 Hz; and second, the fine-structured geomagnetic pulsations that are usually described in periods rather than frequency, which would occur in the mHz range.

Both are geophysical phenomena. More is known about the generation mode of the Schumann resonance than about the source of geomagnetic pulsations. The resonance mode depends upon characteristics of the ionosphere in relation to the earth's surface. Theoretically, once a signal is within the spherical wave guide, it would propagate indefinitely within the closed boundary.

A review by Bannister [24] of ELF technology indicates that known ELF and VLF propagation demonstrates a clear diurnal variation. Less attenuation of signals (more intense fields) occurs during local nighttime than during day. There are also anomalous nighttime propagations characterized by a rapid decrease in ELF field strength over a period of several hours. These severe night time disturbances sometimes occur during the several days following magnetic storms.

These temporal patterns are compatible with the analyses of Schaut and Persinger [2] and Persinger [3], who found that T-C experiences were more likely to occur on days when global geomagnetic activity was quieter, than it was on the days before or after the experiences. During these quiet geomagnetic conditions, there would have been less disturbance of the Schumann wave guide. According to this model, if the agent were exposed to a crisis condition at such times, then its characteristics would have a greater probability of influencing the experient. This assumes that a receptive state was temporally contiguous with the event.

The ELF-TC Interface

Unfortunately, the least conceptually developed aspect of ELF models for T-C is the mechanism by which the specific information about the agent or the situation reaches the experient. As mentioned previously, the stimulus is not required to contain all of the information contained in the experience, merely the appropriate sequence to trigger hippocampal retrieval.

This model assumes that T-C stimuli utilize the ELF mode and hence can be influenced by global geomagnetic storm conditions. Statistically, the T-C signal would also be influenced by smaller perturbations, including those generated by man-made sources. The modern environment is replete with ELF noise and structures that modulate local geomagnetic configurations.

However, the physical mechanism by which the information reaches or influences the experient, even if it uses the ELF mode, is not clear. It has been suggested that the ambient ELF EM fields are modulated by changes in the agent. Other approaches suggest that the signals originate from the brain itself and are propagated within the wave guide as actual signals, but this mechanism does not have a contemporary equivalent in known principles. The reader is referred to an excellent review of this problem by E. Rauscher [25].

One option that has not been pursued is that quiet geomagnetic conditions do not alter the mode by which T-C stimuli influence the experient; rather, the quiet global conditions (and whatever specific geophysical stimuli are

associated with these periods) have an effect upon the experient himself, increasing the likelihood that the experient will display T-C. This option would imply that the occurrence of T-C stimuli would not be changed by geomagnetic activity, but that the recipient's ability to detect these stimuli would be altered, presumably by increasing the sensitivity of deep temporal lobe structures.

General Implications for T-C Experiences

The correlational analysis of Schaut and Persinger [2] and the discussion in the present article indicate that some kinds of T-C experiences are more likely to occur (1) during quiet global geomagnetic conditions; (2) during periods of pain (death or crisis), novelty or frustrative non-reward to the agent; and (3) when the temporal lobe of the experient is displaying labile electrical activity, such as during dreams or decreased vigilance. The fact that large numbers of crises or deaths are not associated with T-C experiences may indicate that all three of these major conditions must be present.

If T-C experiences utilize long-term potentiation within the hippocampus, then only a brief stimulus presentation would be required to evoke long-term changes in the experient. If the LTP sequence is appropriate, it would access massive amounts of information from cerebral cortical columns in the experient. The details of the experience would be determined by the sequence of the stimulus that initiated the LTP and the experient's learning history.

Access to this information would be more likely during periods of disinhibition when these LTP-initiated changes would penetrate awareness. Normally, these conditions occur during dreams or twilight states, but if the stimulation and LTP are sufficiently intense they may be experienced during the waking state. The experiences would be similar to those associated with direct surgical stimulation of deep temporal lobe structures. Essentially, the heightened stimulation would allow intense imagery to be experienced by the recipient.

The social and perceptual context of the situation at the time of stimulation may influence or distort the content

of the imagery. Incidental patterns of the immediate environment (walls, room setting) in experimental situations might influence the content of the imagery following the T-C evoked LTPs. Hence experimental situations should include relatively neutral perceptual backgrounds where the imagery of the T-C stimulation could occur without modification.

Because access during the waking state to cortical activity is graded, intense hippocampal imagery evoked by T-C stimulation should occur in bursts. One would expect that T-C sensitive subjects should report vivid images that occur in sudden (within seconds) impulsive displays. The affective and profound emotional correlates of the T-C experience should be related proportionally to the intensity of the imagery.

T-C experiences should be more evident for people who show temporal lobe lability. Although all of us display daily periods of temporal lobe sensitivity as well as less frequent episodes (associated with fatigue, hormonal fluctuations, hypoxia, etc. [10]), some people may have chronic lability, and should display many of the personality and behavioral correlates of patients who display focal complex partial epilepsy. These symptoms include deepening of affect, absences, inundation by vivid imagery, concern with nascent themes (often with a mystical overtone), viscosity, circumstantiality, and a sense of the personal [10]. However, T-C sensitive individuals would not necessarily display epileptic activity in a technical sense and many (but not all) of their T-C experiences would be correlated with veridical events.

Certain types of T-C events should have a stronger impact upon the brain of the experient than others. Although the characteristics of T-C experiences indicate that deaths and crises are more often associated with intense T-C stimuli than other situations, the preponderance of these cases in the literature may reflect other psychological consequences (learning about the death through conventional means) that occur after the experience. Theoretically any kind of situation that is associated with frustration or novelty should generate potential T-C stimuli; however, their detection would depend upon optimal environmental and experient conditions.

In addition, any perceptual situation that generated specific hippocampal patterns should be associated with T-C stimuli. Discrete, unique, and novel stimuli are obvious candidates. By learning more about the types of perceptual patterns to which the temporal lobe structures optimally respond, we should be able to isolate optimal T-C stimuli. Some may be species-specific and involve unexpected target materials; for example, there are cells within the monkey's temporal cortices that respond optimally and only to the pattern of a monkey's hand.

One final implication of this model involves the morphological changes that are evoked within the hippocampus and adjacent cortices by LTP. Experimental preparations indicate that alterations in synaptic growth (and hence the pattern of neuronal electrical patterns) can occur within minutes of a single stimulation. Traditionally, these changes have been argued to be associated with memory consolidation.

If T-C stimuli can evoke similar LTP then they also might induce changes in synaptic growth and micromorphology of the temporal lobe dendrites. This indicates that T-C stimuli may alter memory consolidation or induce the formation of memories that were not acquired through conventional means. Once these changes occurred, the correlated memories would be experienced as real as any other memory, even though they had not occurred in a technical sense. The implications of this formulation remain to be developed.

References

1. Persinger, M.A. The Paranormal: Part I. The Patterns (New York: M.S.S. Information, 1974).
2. Schaut, G.B., & Persinger, M.A. "Subjective Telepathic Experiences, Geomagnetic Activity and the ELF Hypothesis: Part I. Data Analysis," Psi Research, Vol. 4, No. 1 (1985), pp. 4-20.
3. Persinger, M.A. "Spontaneous Telepathic Experiences from the Gurney, Myers and Podmore Collection Occurred on Days That Displayed Low Global Geomagnetic Activity," Journal of the Amer. Society for Psychical Research (in press).

4. Gurney, E., Myers, F.W.H., & Podmore, F. Phantasms of the Living (London: Trueber & Co., 1886).
5. Stevenson, I. "Telepathic Impressions: A Review and Report of Thirty-Five New Cases," Proceedings of the American Society for Psychical Research, Vol. 29 (1970), pp. 1-198.
6. Sanwald, G. "On the Psychology of Spontaneous Paranormal Phenomena," International Journal of Parapsychology, Vol. 5 (1963), pp. 274-292.
7. Prasad, J., & Stevenson, I. "A Survey of Spontaneous Psychical Experiences in School Children of Uttar Pradesh, India," International Journal of Parapsychology, Vol. 10 (1968), pp. 241-261.
8. Roll, W.G. "Understanding the Poltergeist," In W.G. Roll, ed., Handbook of Parapsychology (Metuchen, NJ: Scarecrow Press, 1978), pp. 183-195.
9. Neppe, V.M. "Temporal Lobe Symptomatology in Subjective Paranormal Experients," Journal of the American Society for Psychical Research, Vol. 77 (1983), pp. 1-31.
10. Persinger, M.A. "Religious and Mystical Experiences as Artifacts of Temporal Lobe Function: A General Hypothesis," Perceptual and Motor Skills, Vol. 57 (1983), pp. 1255-1262.
11. Ojemann, G.A. "The Intrahemispheric Organization of Human Language, Derived with Electrical Stimulation Techniques," Trends in Neuroscience, Vol. 6, No. 5 (1983), pp. 184-189.
12. Goldensohn, E.S. "Symptomatology of Nonconvulsive Seizures: Ictal and Postictal," Epilepsia, Vol. 24, No. 1 (1983), pp. 5-21.
13. Horowitz, M.J., & Adams, J.E. "Hallucinations on Brain Stimulation: Evidence for Revision of the Penfield Hypothesis," In W. Keup, ed., Origin and Mechanisms of Hallucinations (New York: Plenum, 1970), pp. 13-20.
14. Halgren, E., Walter, R.D., Cherlow, D., & Crandall, P.H. "Mental Phenomena Evoked by Electrical Stimulation of the Human Hippocampal Formation and Amygdala," Brain, Vol. 101 (1978), pp. 83-117.
15. Persinger, M.A. "Propensity to Report Paranormal Experiences Is Correlated with Temporal Lobe Signs," Perceptual and Motor Skills, Vol. 59 (1984), pp. 583-586.

16. Persinger, M.A., & Valliant, P.M. "Temporal Lobe Signs and Reports of Subjective Paranormal Experiences in a Normal Population: A Replication," Perceptual and Motor Skills, Vol. 60 (1985), pp. 903-909.
17. Greenough, W.T. "Structural Correlates of Information Storage in the Mammalian Brain: A Review and Hypothesis," Trends in Neurosciences, Vol. 7, No. 7 (1984), pp. 229-233.
18. Lynch, G., & Baudry, M. "The Biochemistry of Memory: A New and Specific Hypothesis," Science, Vol. 224 (1984), pp. 1057-1063.
19. Puthoff, H.E., & Targ, R. "A Perceptual Channel for Information Transfer Over Kilometer Distances: Historical Perspectives and Recent Research," Proceedings of the IEEE, Vol. 64 (1976), pp. 329-354.
20. Teyler, T.J., & DiScenna, P. "The Topological Anatomy of the Hippocampus: A Clue to its Function," Brain Research Bulletin, Vol. 12 (1984), pp. 711-719.
21. Hess, R., Urech, E., & Wieser, H.G. "Arousal Patterns in Depth Recordings from Epileptics," In M.B. Sterman, M.N. Shouse, & P. Passouant, eds., Sleep and Epilepsy (New York: Academic, 1983), pp. 209-217.
22. Gray, J.A. "A Neuropsychological Theory of Anxiety," In C.E. Izard, ed., Emotions in Personality and Psychopathology (New York: Plenum, 1979).
23. Persinger, M.A. "ELF Field Mediation in Spontaneous PSI Events: Direct Information Transfer of Conditioned Elicitation?" Psychoenergetic Systems, Vol. 3 (1979), pp. 155-169.
24. Bannister, P.R. "ELF Propagation Update," IEEE Journal of Oceanic Engineering, Vol. OE-9, No. 9 (1984), pp. 179-188.
25. Rauscher, E.A. "The Physics of Psi Phenomena in Space and Time: Part I. Major Principles of Physics, Psychic Phenomena, and Some Physical Models," Psi Research, Vol. 3, No. 2 (1983), pp. 64-88.

Neuroscience Laboratory
Department of Psychology
Laurentian University
Sudbury, Ontario P3E 2C6